WHAT IS CLAIMED IS:

1. An organic substance removing method of removing an organic substance having an ion-implanted region, from above a substrate by utilization of a plasma of at least an oxygen-containing gas, the method comprising:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing an oxygen-containing gas into a reaction chamber without introducing a fluorine-containing gas thereinto, and generating a plasma of the gas introduced into the reaction chamber to effect a plasma processing.

2. An organic substance removing method of removing an organic substance having an ion-implanted region, from above a substrate by utilization of a plasma of at least an oxygen-containing gas, the method comprising:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas and an oxygen-containing gas into a reaction chamber such that the concentration of the fluorine-containing gas is not more than 0.01 vol%, and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

3. An organic substance removing method of removing an organic substance having an ion-implanted region, from above a substrate by utilization of a plasma of at least an oxygen-containing gas, the method comprising:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas into a reaction chamber such that the concentration of the fluorine-containing gas is lower than the concentration of the fluorine-containing gas introduced in the first step, and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

4. An organic substance removing method of

removing an organic substance having an ion-implanted region, from above a substrate by utilization of a plasma of at least an oxygen-containing gas, the method comprising:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas into a reaction chamber such that the concentration of the hydrogen-containing gas is higher than the concentration of the hydrogen-containing gas introduced in the first step, and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

5. An organic substance removing method of removing an organic substance having an ion-implanted region, from above a substrate by utilization of a plasma of at least an oxygen-containing gas, the method comprising:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction

chamber to effect a plasma processing; and

the second step of introducing into a reaction chamber a gas less prone to etch an exposed surface of the substrate than the gases introduced in the first step, and generating a plasma of the gas introduced into the reaction chamber to effect a plasma processing.

6. The organic substance removing method according to any one of Claims 1 to 5, wherein the fluorine-containing gas comprises at least one selected from fluorine gas, a nitrogen fluoride gas, a sulfur fluoride gas, and a carbon fluoride gas.

7. The organic substance removing method according to any one of Claims 1 to 5, wherein the hydrogen-containing gas comprises at least one selected from hydrogen gas and a gas of a hydrogen compound.

8. The organic substance removing method according to any one of Claims 1 to 5, wherein the density of the plasma in the first step is not less than 1×10^{11} cm^{-3}.

9. The organic substance removing method according to any one of Claims 1 to 5, wherein the heating temperature of the substrate in the first step

is not higher than the heating temperature of the substrate in the second step.

10. The organic substance removing method according to any one of Claims 1 to 5, wherein in the first step, fluorine is implanted from the plasma into the organic substance having phosphorus, arsenic or boron implanted thereinto, to effect modification of a surface of the organic substance.

11. The organic substance removing method according to any one of Claims 1 to 5, wherein the light emission from the plasma is monitored and the processing is transferred from that of the first step to that of the second step, based thereon.

12. The organic substance removing method according to any one of Claims 1 to 5, wherein the elapsed time in the first step is measured and the processing is transferred from that of the first step to that of the second step, based thereon.

13. The organic substance removing method according to any one of Claims 1 to 5, wherein before a region deteriorated by ion implantation is completely removed in the first step, the processing is transferred from that of the first step to that of the

second step.

14. The organic substance removing method according to any one of Claims 1 to 5, wherein the first step and the second step are carried out in a common reaction chamber.

15. The organic substance removing method according to any one of Claims 1 to 5, wherein the organic substance is a patterned resist.

16. A method of producing a semiconductor device, comprising:

the step of forming a patterned organic substance on a substrate comprising a semiconductor region;

the step of implanting ions into the semiconductor region, utilizing the organic substance as a mask; and

the organic substance removing step of removing the ion-implanted organic substance from above the substrate by utilization of a plasma of a gas containing at least oxygen,

wherein the organic substance removing step comprises:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction

chamber to effect a plasma processing; and

the second step of introducing an oxygen-containing gas into a reaction chamber without introducing a fluorine-containing gas thereinto, and generating a plasma of the gas introduced into the reaction chamber to effect a plasma processing.

17. A method of producing a semiconductor device, comprising:

the step of forming a patterned organic substance on a substrate comprising a semiconductor region;

the step of implanting ions into the semiconductor region, utilizing the organic substance as a mask; and

an organic substance removing step of removing the ion-implanted organic substance from above the substrate by utilization of a plasma of a gas containing at least oxygen,

wherein the organic substance removing step comprises:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas and an oxygen-containing gas into a

reaction chamber such that the concentration of the fluorine-containing gas is not more than 0.01 vol%, and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

18. A method of producing a semiconductor device, comprising:

the step of forming a patterned organic substance on a substrate comprising a semiconductor region;

the step of implanting ions into the semiconductor region, utilizing the organic substance as a mask; and

an organic substance removing step of removing the ion-implanted organic substance from above the substrate by utilization of a plasma of a gas containing at least oxygen,

wherein the organic substance removing step comprises:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas into a reaction chamber such that the concentration of the fluorine-containing gas is lower than the concentration of the fluorine-

containing gas introduced in the first step, and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

19. A method of producing a semiconductor device, comprising:

the step of forming a patterned organic substance on a substrate comprising a semiconductor region;

the step of implanting ions into the semiconductor region, utilizing the organic substance as a mask; and

an organic substance removing step of removing the ion-implanted organic substance from above the substrate by utilization of a plasma of a gas containing at least oxygen,

wherein the organic substance removing step comprises:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas into a reaction chamber such that the concentration of the hydrogen-containing gas is higher than the concentration of the hydrogen-containing gas introduced in the first step, and

generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing.

20. A method of producing a semiconductor device, comprising:

the step of forming a patterned organic substance on a substrate comprising a semiconductor region;

the step of implanting ions into the semiconductor region, utilizing the organic substance as a mask; and

an organic substance removing step of removing the ion-implanted organic substance from above the substrate by utilization of a plasma of a gas containing at least oxygen,

wherein the organic substance removing step comprises:

the first step of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and generating a plasma of the gases introduced into the reaction chamber to effect a plasma processing; and

the second step of introducing into a reaction chamber a gas less prone to etch an exposed surface of the substrate than the gases introduced in the first step, and generating a plasma of the gas introduced into the reaction chamber to effect a plasma processing.

21. The method according to any one of Claims 16 to 20, wherein the fluorine-containing gas comprises at least one selected from fluorine gas, a nitrogen fluoride gas, a sulfur fluoride gas, and a carbon fluoride gas.

22. The method according to any one of Claims 16 to 20, wherein the hydrogen-containing gas comprises at least one selected from hydrogen gas and a gas of a hydrogen compound.

23. The method according to any one of Claims 16 to 20, wherein the density of the plasma in the first step is not less than 1×10^{11} cm^{-3}.

24. The method according to any one of Claims 16 to 20, wherein the heating temperature of the substrate in the first step is not higher than the heating temperature of the substrate in the second step.

25. The method according to any one of Claims 16 to 20, wherein in the first step, fluorine is implanted from the plasma into the organic substance having phosphorus, arsenic or boron implanted thereinto, to effect modification of a surface of the organic substance.

26. The method according to any one of Claims 16 to 20, wherein the light emission from the plasma is monitored and the processing is transferred from that of the first step to that of the second step, based thereon.

27. The method according to any one of Claims 16 to 20, wherein the elapsed time in the first step is measured and the processing is transferred from that of the first step to that of the second step, based thereon.

28. The method according to any one of Claims 16 to 20, wherein before a region deteriorated by ion implantation is completely removed in the first step, the processing is transferred from that of the first step to that of the second step.

29. The method according to any one of Claims 16 to 20, wherein the first step and the second step are carried out in a common reaction chamber.

30. The method according to any one of Claims 16 to 20, wherein the organic substance is a resist comprised of a photosensitive resin.

31. The method according to any one of Claims 16

to 20, wherein the substrate comprises a surface comprised of at least one selected from silicon or a silicon compound, exposed out from the organic substance.

32. An organic substance removing apparatus for removing an organic substance having an ion-implanted region, from a substrate, comprising:

a vessel;

means for evacuating the vessel;

a gas introducing system for introducing a gas containing oxygen, hydrogen, and fluorine into the vessel;

a control device for controlling the gas introducing system; and

a power supply for supplying an electric energy for inducing a plasma of the gas introduced into the vessel,

wherein the control device sets the gas introducing system in a first mode of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and then, after lapse of a predetermined time thereafter, transfers the gas introducing system into a second mode selected from four modes of:

1) a mode of introducing an oxygen-containing gas into a reaction chamber without introducing a fluorine-

containing gas thereinto;

2) a mode of introducing a fluorine-containing gas and an oxygen-containing gas into a reaction chamber such that the concentration of the fluorine-containing gas is not more than 0.01 vol%;

3) a mode of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas into a reaction chamber such that the concentration of the fluorine-containing gas is lower than the concentration of the fluorine-containing gas introduced in the first mode; and

4) a mode of introducing a fluorine-containing gas, an oxygen-containing gas, and a hydrogen-containing gas such that the concentration of the hydrogen-containing gas is higher than the concentration of the hydrogen-containing gas introduced in the first mode.

33. An organic substance removing apparatus for removing an organic substance having an ion-implanted region, from a substrate, comprising:

a vessel;

means for evacuating the vessel;

a gas introducing system for introducing a gas containing oxygen, hydrogen, and fluorine into the vessel;

a control device for controlling the gas

introducing system; and

a power supply for supplying an electric energy for inducing a plasma of the gas introduced into the vessel,

wherein the control device sets the gas introducing system in a first mode of introducing an oxygen-containing gas, a hydrogen-containing gas, and a fluorine-containing gas into a reaction chamber and then, after lapse of a predetermined time thereafter, transfers the gas introducing system into a second mode of introducing into a reaction chamber a gas less prone to etch an exposed surface of the substrate than the gases introduced in the first mode.